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HOUSING WITH COOLING MEANS  
[Gehaeuse mit Kuehleinrichtung]

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## Specification

The invention relates to a housing with a cooling means for holding at least one electronic device, such as a rack or drawer housing, especially for holding a 19" drawer housing for electronic modules.

These housings are available in the most varied formats, up to cabinet formats (height 2 m) which are then suitable for holding a plurality of devices and racks.

One major problem in these housings is the cooling of the installed devices. Generally each device to be installed has some kind of cooling means (cooling ribs for convection cooling, fan or the like); but this leads to all the devices installed in the housing thermally interacting with one another. This leads to the power supply parts which generate most of the heat often being mounted at the very top in a cabinet, so that the heat released by them does not influence the devices generating less heat. This type of installation is not feasible for reasons of operation and also stability, since the heaviest and least operated devices sit at the top in the cabinet.

If withdrawable fans are installed in the cabinet in order to achieve increased air flow past the devices within the cabinet, these disadvantages are only partially mitigated. In particular, when one of the devices is temporarily removed or the entire installation space is not necessary, the opening which appears in the cabinet must be closed so that the cooling air cannot escape unused. Finally, cooling of individual devices is also complicated since each device must have separate cooling means; this greatly raises the production cost of the devices and moreover uses up installation volume within the devices,

which volume is thus no longer available for the electronic modules which are to be accommodated.

The object of the invention is to develop a housing of the initially mentioned type such that simplified cooling of installed devices and their electronic modules improved in its action is ensured.

This object is achieved by the features given in the characterizing part of Claim 1.

One important aspect of the invention is that the housing itself ensures the cooling air supply for all installed devices. The complexity necessary for this purpose is low compared to individual cooling of the devices, since only at least one ventilation channel and one air recirculation means responsible for cooling of all devices are necessary. This air recirculation means can be mounted at a location (for example, on the cover of a housing or cabinet) which does not waste the usable interior housing space. Likewise the ventilation channel can be mounted where a cavity is available anyway based on the housing construction or the manner of installation of 19" housings. Because there is a ventilation channel, each device can be supplied with air of the same temperature so that the devices are essentially completely decoupled from one another in terms of thermal engineering.

Preferably the air recirculation means comprise a heat exchanger which absorbs the heat from the air supplied to the devices and flowing out of them and transfers it to the ambient air. In this way a closed cooling system can be built so that a tight housing results. These housings are especially well suited for installation in a dusty, humid or in some other way aggressive environment. In addition, the housing, when its interior is completely sealed from the environment, can be

made tight to electromagnetic and/or electrostatic radiation which can travel from the electronic modules to the outside or from the outside into the electronic modules.

Preferably there are channels which extend over and/or under the electronic modules essentially over the entire width and depth of the devices (at least wherever they must be cooled) and they are made such that the air emerging from the ventilation openings of the compressed air channel is routed to the electronic modules and/or the air coming from the electronic modules is routed to the ventilation openings of the intake ventilation channel. In this way, cooling adapted to the respective thermal circumstances of the individual modules is possible so that the available amount of cooling air can be optimally used.

In a first alternative, channels are made in the devices. Preferably in this connection one wall of the channels which faces the electronic modules is made as a mounting unit which has guide strips for holding the modules and ventilation openings and/or breather holes assigned to them for guiding the air flow over the electronic modules. In this way the number of parts necessary for the devices is reduced and with simultaneous optimization of cooling an increase in construction volume is avoided. This mounting unit can at the same time have means for attaching plug strips, by which the number of parts is further reduced.

Preferably the mounting unit is made as a shaped sheet metal part. This shaped sheet metal part can be produced as a half-open shell so that the channel is then formed by the shaped sheet metal part and a device cover. Alternatively, it is possible to make the mounting unit as a peripherally closed hollow body so that one surface of the

mounting unit is equipped with guide strips, and the other surface of the mounting unit forms the device cover.

In another embodiment, channels are made in fan units which can be mounted over and/or under the devices. In particular, this execution is advantageous when they are racks without covers. These fan units are preferably provided with ventilation openings and/or breather holes at locations which correspond to electronic modules over or under the fan unit in the housing of the mounted devices. This is easily possible based on the 19" standard.

In any case, the ventilation openings and/or breather holes can be closed, for which for example simple plastic molded parts are suited. Then those ventilation openings which lie in areas in which heat is not to be dissipated are closed. The ventilation openings can preferably be equipped with air guide means such that an air flow passing through the ventilation openings can be routed in a guided manner onto the electronic modules. This air flow can be free flowing either over greater distances or however can be routed directly to a heat source via hose lines.

Preferably in each of the ventilation channels there is a plurality of ventilation openings which can be closed by blocking means. This ensures that a housing equipped in this way can be used to hold devices with different overall heights. Those ventilation openings which are not assigned to a device are then closed.

The blocking means are preferably made such that they are opened by connection pieces which can be inserted into the ventilation openings. The connecting pieces ensure a tight transition between the ventilation openings in the ventilation channel and air inlet/outlet

openings in the devices.

When devices in the housing are often replaced or are only removed from the housing, it is advantageous if the blocking means of the ventilation openings assigned to a device are opened by means of actuating elements located on this device when the device is inserted and are closed when the device is removed. These actuation elements can at the same time be connecting pieces.

Preferred embodiments of the invention will become apparent from the dependent claims and the following description of exemplary embodiments which are detailed using the figures.

Figure 1 shows a vertical section through a device parallel to an electronic module,

Figure 2 shows a horizontal section through a housing with the device inserted,

Figure 3 shows a section along line III-III from Fig. 1,

Figure 4 shows a partial section along line IV-IV from Fig. 1,

Figure 5 shows a horizontal section through another embodiment of a device similar to the one shown in Fig. 2,

Figure 6 shows a section along line VI-VI from Fig. 5,

Figure 7 shows a schematic vertical section through a device and fan units located above and below it,

Figure 8 shows a perspective of a fan unit,

Figure 9 shows a schematic vertical section through three devices stacked on one another with the pertinent fan units,

Figure 10 shows a perspective diagram of a ventilation channel with a heat exchanger,

Figure 11 shows a perspective of another embodiment of a

ventilation channel with a heat exchanger and parts of the housing,

Figure 12 shows a perspective view (from underneath) of an air recirculation means which is made as a housing cover and which can be used together with a ventilation channel as shown in Fig. 11,

Figures 13 and 14 show sections along lines XIII-XIII and XIV-XIV from Fig. 12 and

Figure 15 shows a schematic vertical section through the rear housing wall with a ventilation channel and devices which have not yet been fully inserted into the housing.


In the following description of exemplary embodiments the same reference numbers are used for the same or identical parts.

A first embodiment of the invention is explained below using Figs. 1 to 4, in which the channels for routing cooling air out of the ventilation channels to the electronic modules are mounted within the device **1**. Such a device **1** comprises front plates **2**, a rear wall **7**, a top and a bottom cover **8**, and frame strips **6**, by means of which these parts and side walls which are not shown can be assembled to form a solid hollow body.

To hold the boards **3** within the device **1** there are guide strips **4** which have claws via which the guide strips **4** can be attached in the mounting openings **45** of mounting units **9** (Fig. 4). The mounting units **9** are attached on the one hand to frame strips **9**, on the other hand they have flanges **43** which are provided with openings in order to attach plug strips **5** thereto.

The mounting units **9** are made flat and extend over essentially the entire width of the device **1**, as is indicated in Fig. 4. Guide strips **4** and mounting openings **45** are assigned openings **16**, **17** which are used as



ventilation or breather openings. (Plastic) sealing pieces can be inserted into these openings **16, 17** if cooling is not desired at the pertinent location. In order to produce an air flow as directional as possible, air guide means **44** (Fig. 3) can be used. 

The mounting units **9** together with the covers **8** form channels **20, 20'**. In the side walls **21, 21'** of the device **1** there is an air inlet opening **18** and an air outlet opening **19** which communicate with the lower channel **20'** and the upper channel **20** respectively. In Fig. 1 the broken lines indicate an air inlet opening **18** which sits in the side wall **21** which is not visible in this figure. Alternatively it is possible to provide both openings in the same side wall, but they are then located offset against one another viewed in the depth of the device **1**, as is indicated in Fig. 1 with the air inlet opening **18'**.

The housing **10** (Fig. 2) is made of four bars **11** which are interconnected via side walls **12** and **13** and a rear wall **14**. The housing **10** is thus open on one side. An (intake) ventilation channel **22** and (pressurized) ventilation channel **23** are attached to the side walls **12, 13**.

Furthermore, the housing **10** has a bottom **15** (see Fig. 6) and a cover which contains an air recirculation means **28** which communicates with the channels **22** and **23** or only with one channel (**22** or **23**) and the device interior and produces an air flow through the channels **22, 23**.

The channels **22, 23** are provided with ventilation openings **26, 27** which are made and attached such that when a device **1** has been inserted into the housing **10**, the opening **27** of the ventilation channel **23** communicates with the air inlet opening **18** of the channel **20'** and the ventilation opening **26** of the ventilation channel **22** communicates with

the air outlet opening **19** of the channel **20**.

In the embodiment of the invention made in this way, when a device **1** has been installed in the housing **10** and the air recirculation means **28** forces air into the (pressurized) ventilation channel **23** and exhausts it from the (intake) ventilation channel **22**, an air flow is produced through the air inlet opening **18**, the channel **20'**, the ventilation openings **16**, past the electronic modules **3**, through the breather openings **17**, the channel **20** and the air outlet opening **19** so that the electronic modules **3** are cooled.

In the embodiment of the device shown in Figs. 5 and 6, again ventilation channels which however both act as intake air channels **22** are attached to the side walls **12**, **13** of the housing **10**. The remaining interior of the housing **10** can thus act as a pressurized ventilation channel **23**. Accordingly the air outlet openings **19** of the device **1** are made on both side walls of the device **1**, while the air inlet openings **18'** (see Fig. 1) discharge freely into the housing interior. Of course it is also possible to provide only one ventilation channel and/or to reverse the air flow direction (intake or pressurized side).

In the embodiment shown in Figs. 7-9, the channels are not within the devices **1**, but within separate fan units **30**. These fan units **30** comprises a cover **31** in which there are ventilation openings **34**. These ventilation openings **34** correspond to the ventilation openings **16** and can thus likewise be closed or can be provided with nozzles or the like.

In the fan unit **30**, under the cover **31** there is an intermediate bottom **32** so that between it and the cover **31** a channel **33** is formed which is supplied via an air inlet opening **18** with compressed air from

the housing interior or a channel **18**.

Underneath the intermediate bottom **32** is another chamber **33** which communicates via an air outlet opening **19** with an (intake) ventilation opening **26**. If as shown in Fig. 9 at least two devices **1** are installed on top of one another in the housing **10**, one fan unit **30** inserted between two devices **1** is used on the one hand for supply of cooling air for the device **1** located above, on the other hand for removing air from the device **1** located underneath. The fan unit **30** located over the last or the one located under the first device **1** requires only a single chamber **33** and **33'** for removal or delivery of cooling air. This embodiment of the invention is especially suited when the racks do not have covers or mounting units **9**, but are made in the conventional manner.

One embodiment of the invention is explained below using Fig. 10, this embodiment having channels **22**, **23** next to one another. The two channels **22**, **23** have a common channel inside wall **24** in which the intake ventilation openings **26** and the pressurized ventilation openings **27** are attached. The two channels **22**, **23** are separated via a partition **37** folded in a meander shape from a cooling air channel **36** through which air is delivered by means of a blower. The ventilation channels **22**, **23** are interconnected on their ends so that together with the channels **20**, **20'** in the devices **1** they constitute a closed recirculation system. This is represented by the arrows in Fig. 10.

In one alternative embodiment of the invention (see Fig. 11) there are two separate cooling air channels **36**, **36'** with a partition **38** which corresponds to the partition between the two ventilation channels **22**, **23**. The cooling air can be supplied by an air recirculation means **28**

which is shown schematically in Figs. 12 and 14. This air recirculation means **28** is provided in the cover or as the cover of a housing and has a blower **29** which allows air to circulate in the channels **22**, **23** and through the devices **1**. Other blowers **29** suck air out of the housing interior (shown in Fig. 14) or out of the vicinity and convey it first through the cooling air channel **36** and then through the cooling air channel **36'** again to the outside. The air flow is shown for illustration in Figs. 11 to 14 with arrows a-d. One important advantage of this embodiment of the invention lies in that the ventilation channels are made at the same time as heat exchangers so that a separate heat exchanger can be omitted.

The ventilation channels can be attached to the side walls of the housing. In this case, preferably elastic sealing lips are attached around the ventilation openings **26**, **27** so that when the device **1** is inserted its side walls tightly adjoin the sealing lips and the openings **17**, **18** sit within the sealing lips.

In the embodiment of the invention shown schematically in Fig. 15, the ventilation channel **23** is attached to the rear wall **7** of a housing and inside has a rubber plate **39** which is attached on the rear side of the inside channel wall **24** and which has flaps **40** which are elastically connected to the rubber plate **39**, for example, via a film hinge, in the regions in which pressurized ventilation openings **27** sit.

The air inlet openings **18** of the devices **1** are provided within a connecting piece **41** which is provided on the rear wall of a device **1** and which can be inserted sealed into a breather opening **27**. If at this point a device **1** equipped in this way is inserted into the housing, the connecting piece **41** opens the flap **40** so that air from the ventilation

channel **23** can travel into the air inlet opening **18** of the device **1**. When the device is removed, the ventilation opening **27** is closed again by the flap **40**.

Alternatively, a separate connecting piece **41'** which remains in the housing can be inserted into a ventilation opening **27**. This connecting piece **41'** likewise opens the flap **40**. The connecting piece **41'** preferably has an elastic area **42** via which sealing to the device **1'** can take place, so that cooling air can be conveyed out of the ventilation channel **23** without escaping into the air inlet opening **18**. Of course it is possible to make these flap mechanisms such that they can be mounted in ventilation channels **22, 23** which sit on the side walls of the housing.

#### Reference number list

|        |               |
|--------|---------------|
| 1      | device        |
| 2      | front plate   |
| 3      | board         |
| 4      | guide strip   |
| 5      | plug strip    |
| 6      | frame strip   |
| 7      | rear wall     |
| 8      | cover         |
| 9      | mounting unit |
| 10     | housing       |
| 11     | bar           |
| 12, 13 | side wall     |
| 14     | rear wall     |
| 15     | bottom        |

|         |                                 |
|---------|---------------------------------|
| 16      | ventilation opening             |
| 17      | breather opening                |
| 18, 18' | air inlet opening               |
| 19      | air outlet opening              |
| 20, 20' | channel                         |
| 21, 21' | device side wall                |
| 22      | intake ventilation channel      |
| 23      | pressurized ventilation channel |
| 24      | inside channel wall             |
| 26      | intake ventilation opening      |
| 27      | pressurized ventilation opening |
| 28      | air recirculation means         |
| 29      | fan                             |
| 30      | fan unit                        |
| 31      | cover                           |
| 32      | intermediate bottom             |
| 33, 33' | pressurized/intake channel      |
| 34      | ventilation opening             |
| 35      | breather opening                |
| 36, 36' | cooling air channel             |
| 37      | partition-heat exchanger        |
| 38      | partition-ventilation channel   |
| 39      | rubber plate                    |
| 40      | flap                            |
| 41      | connecting piece                |
| 42      | elastic region                  |
| 43      | flange                          |

44            air guide means  
45            mounting opening

#### Claims

1. Housing with a cooling means for holding at least one electronic device such as a rack or drawer housing, especially for holding a 19" drawer housing for electronic modules, characterized by at least one ventilation channel (22, 23) which is attached to the housing (10) and which has ventilation openings (26, 27) which are flow-connected directly or indirectly to openings (18, 91) in the device (1) when the device is inserted into the housing, and by air recirculation means (28) for producing a cooling air flow through the ventilation channel (22, 23) and the device (1).

2. Housing as claimed in Claim 1, wherein the air recirculation means (28) comprise a heat exchanger (37, 38) and wherein the air flowing through the ventilation channels (22, 23) and the devices (1) is sealed off essentially tightly from the ambient air (Figs. 10 - 14).

3. Housing as claimed in one of the preceding claims, characterized by channels (20, 20'; 33, 33') which extend over and/or under the electronic modules (3) essentially over the entire width and depth of the devices (1) and are made such that the air emerging from the ventilation openings (27) of the (pressurized) ventilation channel (22, 23) is routed to the electronic modules (3) and/or the air coming from the electronic modules (3) is routed to the ventilation openings (26).

4. Housing as claimed in Claim 3, wherein channels (20, 20') are made in the devices (1) (Figs. 1 to 4).

5. Housing as claimed in Claim 4, wherein one wall of the channels (20, 20') which faces the electronic modules (3) is made as a mounting unit (9) which has guide strips (4) for holding the modules (3) and ventilation openings (16) and/or breather holes (17) assigned to them for guiding the air flow over the electronic modules (3).

6. Housing as claimed in Claim 5, wherein the mounting unit (9) has means (43) for attachment of plug strips (5).

7. Housing as claimed in one of Claims 5 or 6, wherein the mounting unit (9) is made as a shaped sheet metal part.

8. Housing as claimed in one of Claims 5 to 7, wherein the mounting unit (9) is made as a peripherally closed hollow body.

9. Housing as claimed in Claim 3, wherein the channels (33, 33') are attached in the fan units (30) which can be mounted over and/or under devices (1), especially racks (Figs. 5 - 9).

10. Housing as claimed in Claim 9, wherein the fan units (30) have ventilation openings (34) and/or breather holes (35) at locations which correspond to electronic modules (3) over or under the fan unit (30) in the housing (10) of the mounted devices (1).

11. Housing as claimed in one of Claims 5 or 10, wherein the ventilation openings (16, 34) and/or breather holes (17, 35) can be closed.

12. Housing as claimed in one of Claims 5 or 10, wherein the ventilation openings (16, 34) can be equipped with air guide means such that an air flow passing through the ventilation openings (16, 34) can be routed in a guided manner onto the electronic modules (3) or locations on them.



13. Housing as claimed in one of the preceding claims, wherein in the ventilation channel (22, 23) there is a plurality of ventilation openings (26, 27) which can be closed by blocking means (40) (Fig. 15).

14. Housing as claimed in Claim 13, wherein the blocking means (40) are preferably made such that they are opened by connection pieces (41, 41') which can be inserted into the ventilation openings (26).

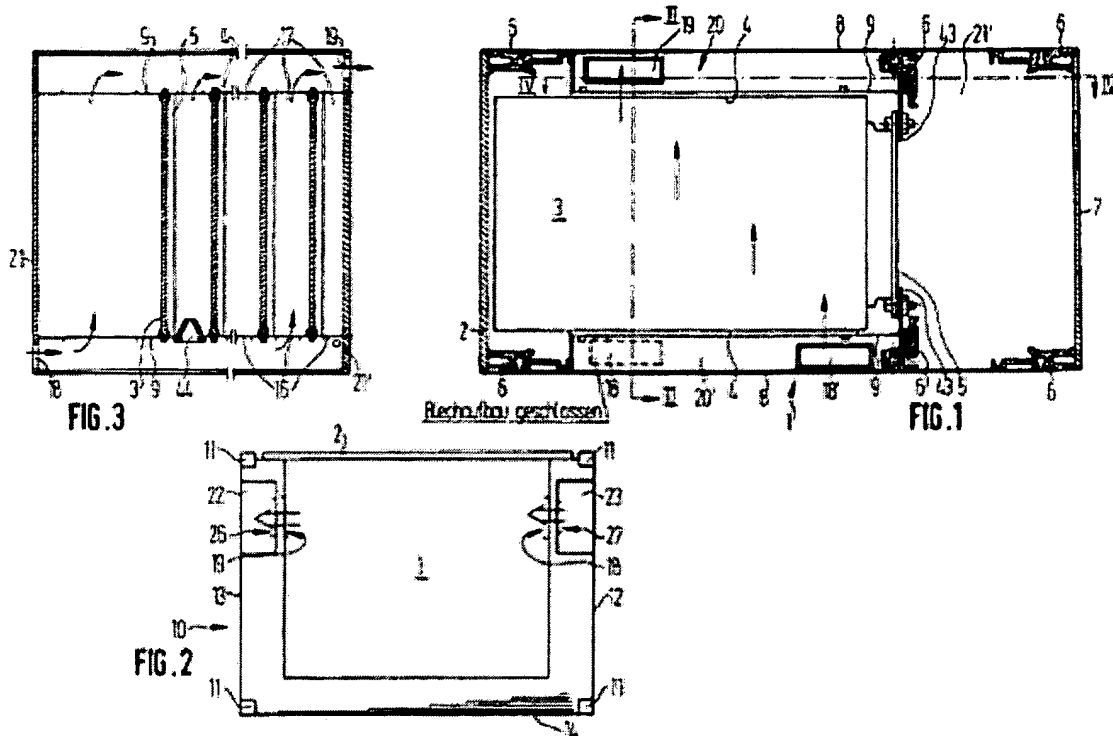
15. Housing as claimed in one of Claims 13 or 14, wherein the blocking means (40) of the ventilation openings (27) assigned to a device (1) are opened by means of actuating elements (41) located on this device (1) when the device (1) is inserted and are closed when the device (1) is removed.

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8 pages of figures attached.  
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Zeichnungen Seite - Drawings page

Nummer - number

Offenlegungstag - Date opened to public inspection



Key for Fig. 1:

Blechaufbau geschlossen=Sheet metal structure closed

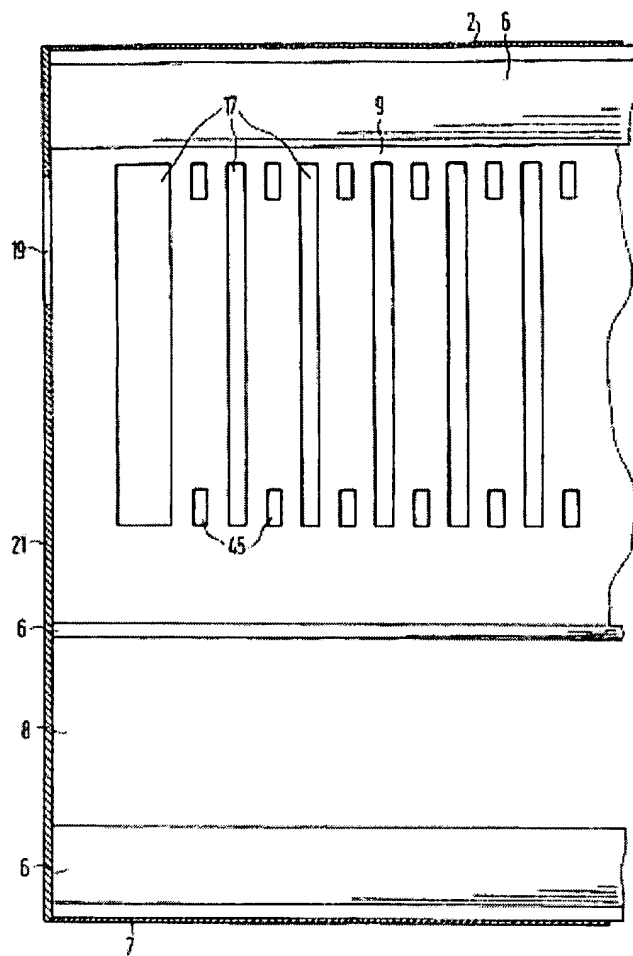
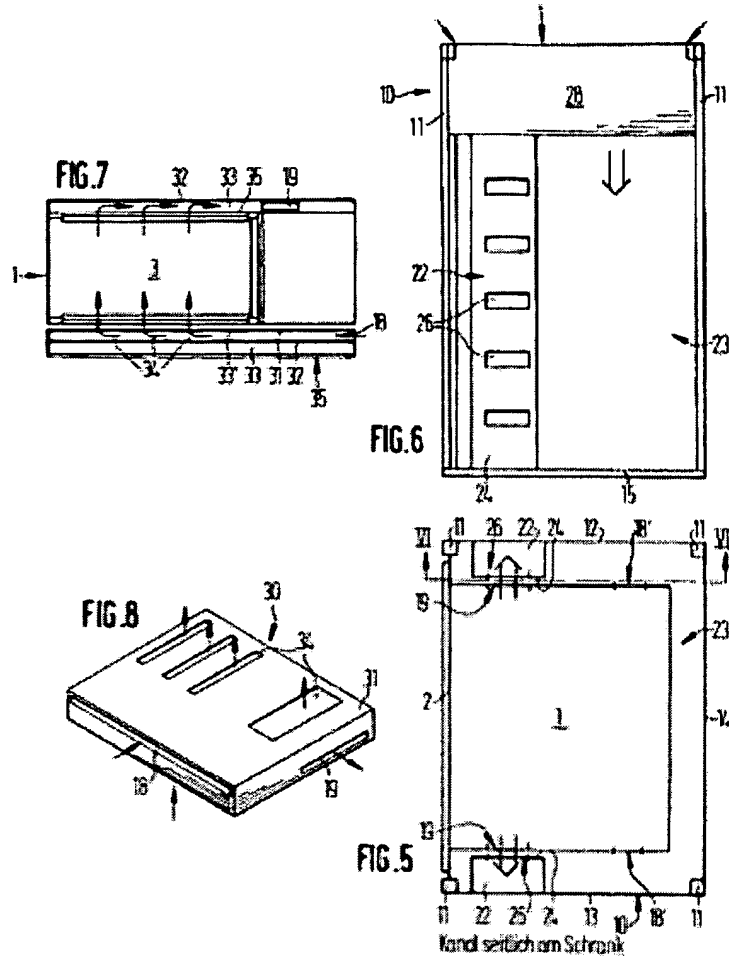


FIG. 4



Lueftereinheit die zwischen BGT gesteckt wird

Key for Fig. 5:

Kanal seitlich am Schrank=Channel laterally on cabinet

Lueftereinheit die zwischen BGT gesteckt wird=Fan unit which is inserted between racks

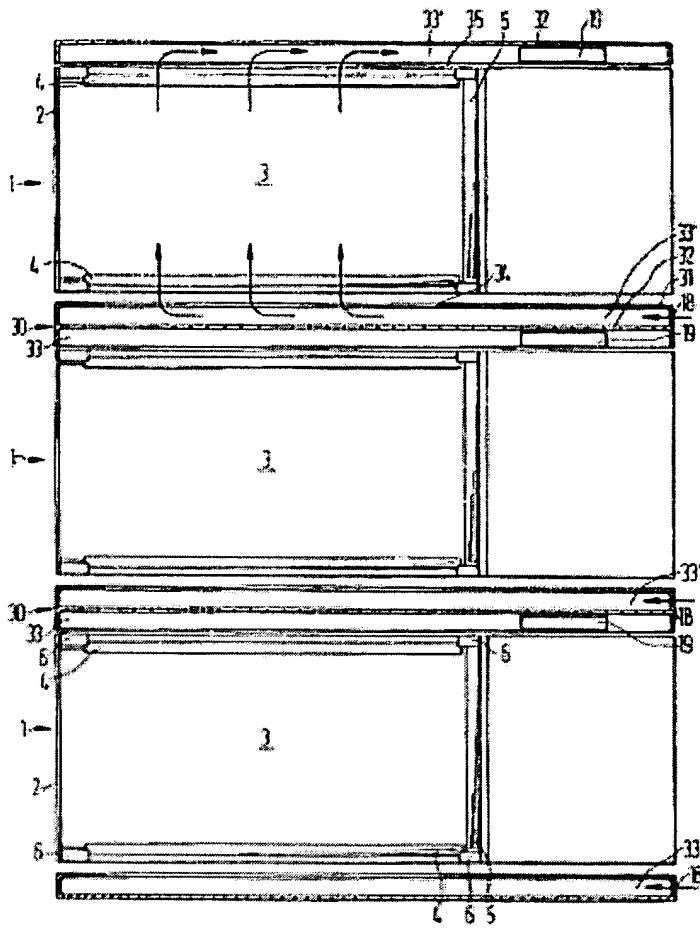
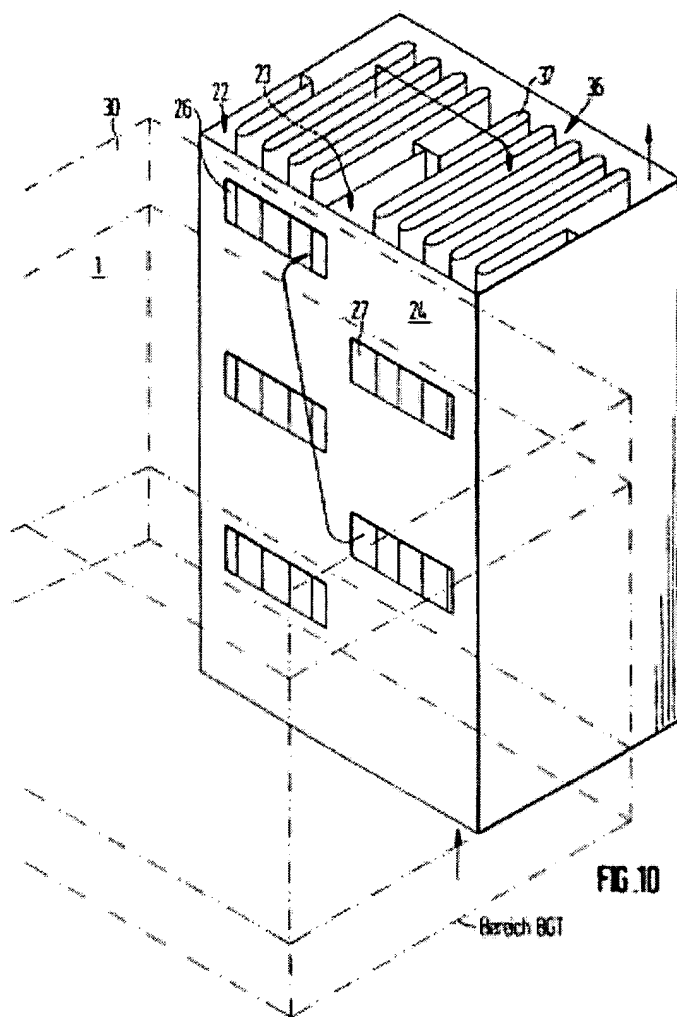


FIG. 9



Key for Fig. 10:  
Bereich BGT=Rack area

FIG. 11

